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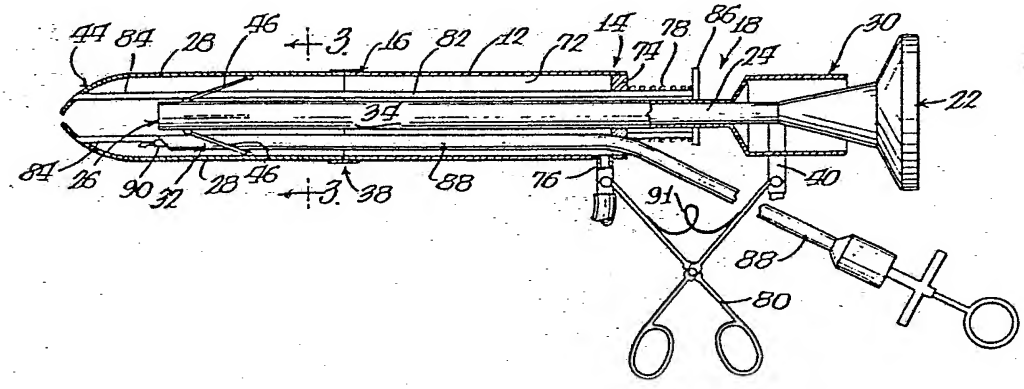

(57) Abstract

A surgical device having an instrument assembly associated with tissue parting means (28) for separating body tissue to provide viewing and operating room for the instrument assembly. A portion of the surgical device (16) is inserted into a patient's body and the tissue parting means (28) engaged to enlarge or create a cavity within the patient's tissue. The tissue can then be viewed by a viewing system (18) carried on the instrument assembly. Tissue collecting means (90) can also be used to obtain tissue samples and laser irradiation can be carried by the assembly (192) to control bleeding and remove tissue.

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SURGICAL DEVICE FOR INTERNAL OPERATIONS

Technical Field of the Invention

This invention relates to surgical devices and more particularly to surgical devices useful for performing a medical procedure on tissue within a patient.

Background of the Invention

The classic technique of surgery includes an emphasis on exposure of the organ or tissue of interest. An incision is made in the skin, usually four to eight inches long, and the underlying muscle disected and split. The skin and muscle tissues are then separated by several inches to provide the surgeon with binocular vision into the created cavity. Such an operation, particularly when through tissue such as the abdominal wall, increases the patient's discomfort and recovery time above that caused by the medical procedure performed.

Such complete exposure is often unnecessary when the tissue is merely to be inspected, a small tumor removed or a tissue biopsy sample obtained. It is ironic that the patient should have to suffer a large amount of discomfort and immobility from a surgical procedure when the tissue of interest could have been removed through a relatively small incision. On the other hand, "blind" biopsy of these tissues may be dangerous or inaccurate because the diseased portion of the tissue may be missed or healthy tissue may be inadvertently destroyed or unnecessarily traumatized.

Endoscopes have been developed which can be inserted through the skin and muscle layers to allow the surgeon to view and collect tissue. However, endoscopes can only be used where there is a relatively large natural cavity or space such as in

the lung, bladder, intestine, or peritoneum. Often medical procedures such as the collection of a biopsy tissue sample must be performed in locations lacking a natural cavity, such as in the kidney or lymph nodes. In portions of the body only having relatively small or no natural cavities, it is difficult if not impossible to use an endoscope.

Accordingly it would be desirable to provide a surgical device which avoids the deficiencies of the prior art and provides a means for visual inspection within tissue lacking a relatively large natural cavity. It would also be beneficial if such a device includes means for performing a medical procedure such as the collection of a biopsy tissue sample or removal of diseased tissue. The present invention meets these desires.

Summary of the Invention

The present invention is a surgical device for the visual inspection of tissue within a patient. The surgical device can also be used to perform medical procedures such as biopsy or tissue sample collection, and tissue ablation by laser irradiation.

The surgical device embodying the present invention generally includes an instrument assembly associated with tissue parting means. The tissue parting means separates body tissue to provide viewing and operation room for the instrument assembly. The tissue parting means generally includes an elongated external tube, at least one tissue retraction member associated with the distal portion of the tube, and actuator means for moving at least a portion of the retraction member radially outwardly of the tube to create or enlarge a cavity in the tissue.

The instrument assembly generally includes a viewing system to permit a surgeon to visually inspect the tissue within and surrounding the produced cavity. The instrument assembly can also include biopsy sampling means or a laser light transmitting fiber. It is not necessary that the tissue be inspected be within or adjacent a relatively large cavity. The surgical device can enlarge an existing small cavity or create one as needed.

The viewing system includes coupling optics which generally remain outside the patient and are used by the surgeon for viewing through a viewing conduit which extends into the external tube. Preferably, the viewing conduit is carried by an internal conduit which protects the viewing conduit and provides a carrier for other components such as a fluid channel or a laser light transmitting fiber.

In a preferred embodiment, the surgical device generally has two or more tissue retracting members or levers which are pivotally mounted on the distal portion of the external tube by hinge means. The actuator means preferably operates by urging the distal ends of the tissue retraction members apart as the internal conduit is moved relative to the external tube. This allows the retraction members to be operated without having an additional connector extending through the external tube. The result is not only an increased reliability, but also a decrease in the diameter of the device.

Numerous other advantages and features of the present invention will become readily apparent from the following detailed description of the invention, accompanying examples, drawings and appended claims.

Brief Description of the Drawings

FIGURE 1 is a side elevational view, partly in section, showing a surgical device embodying the present invention;

FIGURE 2 is an enlarged fragmentary view, partly in section, of the distal portion of the surgical device with tissue retraction members extended;

FIGURE 3 is an enlarged, cross-sectional view taken generally along plane 3-3 of FIGURE 1 showing the internal structure of the surgical device;

FIGURE 4 is a fragmentary side-elevational view of the distal portion of an alternative surgical device embodying the present invention;

FIGURE 5 is a fragmentary side-elevational view, partly in section, of the distal portion of the alternative embodiment shown in FIGURE 4;

FIGURE 6 is an enlarged, cross-sectional view taken generally along plane 6-6 of FIGURE 5 showing the internal structure of the alternative embodiment;

FIGURE 7 is a fragmentary side elevational view of the distal portion of a further alternative embodiment; and

FIGURE 8 is an enlarged, cross-sectional view taken generally along plane 8-8 of FIGURE 7 showing the internal structure of the alternative embodiment.

Description of the Preferred Embodiments

While this invention is susceptible of embodiment in many different forms, there are shown in the drawings and will be described in detail, preferred embodiments of the invention. It should be understood, however, that the present disclosure is to be considered as an exemplification of the

principles of the invention and is not intended to limit the invention to the embodiments illustrated.

The precise shapes and sizes of the components described are not essential to the invention unless otherwise indicated. For ease of description, the term "distal" refers to the direction toward the end which is inserted into the patient, and the term "proximal" refers to the direction toward the end which remains outside the patient.

The present invention is a surgical device which aids in the visual inspection of tissue within a patient by creating or enlarging a cavity within the tissue. The surgical device enables the surgeon to inspect and even perform a medical procedure on tissue lacking a natural or relatively large cavity.

Referring to FIGURES 1 through 3, the surgical device generally comprises an elongated external tube 12 having proximal 14 and distal end portions 16, and a viewing system 18. The surgical device also includes at least one tissue retraction member or lever 28 operably associated with the distal end portion 16 of the tube 12 and actuator means 32 for urging at least a portion of the lever radially outwardly of the tube. The tissue retraction member is preferably an elongated structure such as lever 28. The lever and a portion of the tube 12 can be inserted into the patient and the actuator means 32 and lever 28 engaged to create or enlarge a cavity within the tissue to facilitate inspection with the viewing system.

The viewing system 18 includes coupling optics 22, most of which are located in a handle 30 mounted on the distal end of the internal conduit 34 operably associated with a viewing conduit 24. The

viewing system 18 also includes light transmitting means such as a light transmitting fiber 36 for emitting light beyond the probe end 26 and into the created cavity. The light transmitting means can also include light source coupling 40 for operably connecting the light transmitting fiber 36 to a light source (not shown). Preferably the viewing conduit 24 and fiber 36 are carried by an internal conduit 34 and are coterminous with the probe end 26 of the internal conduit. This provides protection for the viewing conduit 24 and fiber 36. The internal conduit can also carry other elements which are described in more detail below.

The viewing system can use any suitable type of viewing conduit. These types of viewing conduits include fiberoptic bundles, thin lens systems, rod lens systems and graded index (GRIN) systems. A GRIN system is prefered because of its relatively small size and its high quality of visualization. The GRIN system can be provided with movable, totally or partially reflective mirrors to enable laser light to be transmitted through the system. The GRIN system automatically focuses the laser light. The operation of viewing conduits and coupling optics is well known in the art and need not be described in further detail.

The surgical device is preferably provided with one or two pairs of tissue retracting levers 28 with the levers being pivotally mounted on the distal end portion 16 of the tube 12 by hinge means 38. The hinge means can be pieces of spring strap welded between the tube 12 and the levers 28 or alternatively, of a standard hinge design. The levers 28 preferably matingly can fit together to form a sheath having a pointed end for insertion

through a surgical opening cut in a patient.

In one preferred embodiment the actuator means 32 urges the distal ends 44 of the levers 28 apart when the viewing system 18 or internal conduit 34 is moved relative to the external tube 12. The external tube 12 and the internal conduit 34 should be substantially rigid to facilitate such movement. As shown in the embodiment of FIGURES 1-3 the actuator means 32 includes a mechanical linkage 46 mechanically interconnecting the internal conduit 34 and the levers 28. As the internal conduit 34 is moved proximally with respect to the external tube 12, the mechanical linkage 46 extends outwardly to urge the distal ends 44 levers 28 apart. Alternatively, the levers could be urged apart as the internal conduit 34 is moved distally, or other means can be utilized for that purpose, e.g., a rotatable rod or conduit.

Alternatively as shown in FIGURES 4-6 the actuator means 132 can include camming means 154 carried by the external tube 112 and viewing system or internal conduit 134. The camming means 154 includes a bead 156 carried by the internal conduit 134 which cooperates with a tab 158 on each lever 128 so that the distal ends 144 of the levers are urged apart as the conduit 134 is moved longitudinally with respect to the external tube 112. As shown in FIGURE 5, the distal ends 144 of the levers 128 are urged apart when the internal conduit 134 is moved distally. Alternatively the bead 156 can be located on the internal conduit 124 such that the distal ends 144 of the levers 128 are urged apart when the internal conduit is moved proximally.

Referring again to FIGURES 1-3, the surgical device can be provided with a hose 82 to help remove any debris and the like or to supply a washing fluid action. The hose 82 extends through the external

tube 12 and with the distal portion 84 of the hose carried by one of the levers 28. The hose is preferably semi-rigid and manufactured of stainless steel. The end of the hose 82 is preferably fixed on the distal end 44 of the lever 28 and penetrates the lever to direct fluid into the produced cavity. A plurality of hoses 82, as shown in FIGURES 1-3, one for each lever 28 can be provided and interconnected by a loop 86 for placing the hoses in fluid communication with a fluid or vacuum source (not shown). Thus, the combination of the hoses 82 and fluid passageway 72 permit the introduction of a flushing fluid and removal of any fluid which may obstruct the view.

A collet 74 seals between the proximal end 14 of the external tube 12 and the internal conduit 34 and the conduit and tube 12 define a fluid passageway 72 between them. The fluid passageway 72 can be placed in fluid communication with a suction or fluid source (not shown) through fluid inlet 76. A clear fluid such as carbon dioxide or saline can be introduced through inlet 76, the fluid passageway 72, and into the cavity enlarging and clearing the cavity.

To assist in moving the internal conduit 34 with respect to the external tube 12, the surgical device can be provided with an actuator such as tongs 80. The tongs are interconnected between the tube 12 and handle 30 as by being mounted on the fluid inlet 76 and the light source coupling 40. Biasing means such as compression spring 78 can be positioned between the external tube 12 as against collet 74, and the loop 86. This places tension on the hoses 82 which assist in closing the retraction levers 28 by urging them toward the axis of the tube. The use of tension on the hoses 82 as a closing mechanism has

its greatest mechanical advantage when the levers are closest together. This reduces the force needed from the actuator means and to close the levers, reducing wear and decreasing the risk of breakage. Loop spring 91 can be placed on the tongs to provide additional bias. In the rest position the tissue retraction levers are closed and the surgeon need only apply force to the tongs 80 after the surgical device is inserted into the patient to permit viewing. Alternatively the loop spring 91 can be used to bias the conduit 34 into a proximal position with the tissue levers open.

The movement of the internal conduit 34 and viewing system 18 relative to the external tube 12 to operate the tissue retraction levers 28 is particularly advantageous. It is unnecessary to have a separate lever operating connections extending through the tube which would waste space and increase the size of the tube and the hole which must be made in the patient. There is also greater reliability and safety for the patient without such separate connections. Sterilization of the relatively open fluid passageway 72 is also easier.

The surgical device may also be provided with an access channel 88 which extends within external tube 12. The access channel 88 can be used to position tissue collection or biopsy sampling means through the device and into the cavity created by the tissue levers 28. FIGURES 1-3 show biopsy sampling means 90 extending through the access channel 88. The end of the biopsy sampling means is inserted into the tissue and on removal, it takes a small sample with it. Other instruments such as a laser transmitting fiber, a suction hose, or an injection needle may be operated through the access

channel 88.

As best seen in FIGURE 6, in addition to a viewing conduit 124, an access channel 188, and a light transmitting fiber 136, means for emitting laser irradiation can be located within the tube. This laser irradiation emitting means can include a laser light transmitting fiber 192 carried by the internal conduit 134. The internal conduit 134 can also carry other light transmitting systems. The laser light transmitting fiber 192 is preferably a single quartz glass fiber surrounded by a protective sheath. The viewing bundle 124 and laser light transmitting fiber 192 preferably extend within the internal conduit 134 and are substantially coterminous with the probe end 126.

A replaceable transparent window 194 can be mounted on the probe end 126 of conduit and positioned on the distal end of the laser light transmitting fiber 192 to protect the end of the fiber. The window should be of glass or quartz and can include a lens to focus the laser light at a specific distance. Should the window become damaged, it may be replaced, avoiding the costly necessity of replacing the entire laser light transmitting fiber 192. The internal conduit 134 can also be provided with a fluid tube 196 having a cowl 198 for directing flushing fluid over the window 194 to prevent the collection of debris.

Any suitable laser can be used with the laser light transmitting fiber 192 or a GRIN system, such as ruby rod, argon or neodymium-YAG (yttrium-aluminum-garnet) laser light. A carbon dioxide laser can be employed if a wave guide as known in the art is used, instead of a laser light transmitting fiber 192. The blue-green wavelength of

a argon or neodymium-YAG laser is particularly useful for blood coagulation while the infared wavelength of a carbon dioxide laser is particularly useful for the removal of tissue.

The tissue levers 128 also serve to space the tissue which will be irradiated by the laser from the end of the laser light transmitting fiber 192. It is preferred to use a YAG laser with 0.1 second exposures intermittently to stop bleeding or remove tissue.

An embodiment having a deflectable internal conduit is shown in FIGURES 7 and 8. As before, the retraction members 228 are pivotably mounted on the distal end portion 216 of the elongated tube 212. The internal conduit carries a laser light transmitting fiber 292, a viewing conduit 224, a light transmitting fiber 236 and an access channel 288. All of these elements extend and operate through an end wall 233 of the internal conduit 234.

The internal conduit 234 is articulated at its distal portion by flexing means such as elastic collar 235 about the conduit so that the distal portion of the internal conduit and viewing system can be deflected relative to the axis of the tube 212 or the axis of the internal conduit. In this embodiment, the surgical device also includes directing means for deflecting the probe end and viewing system. Preferably, this directing means includes one or more cables 298 which extend within the internal conduit 234 and have one end fixed on the end wall 233. By placing tension on one or more wires, the probe end is deflected so that it is possible to change the area of viewing as well as aim emitted laser irradiation at a selected site.

As an example, one area where it is

desirable to obtain biopsy tissue samples from a part of the body lacking a natural cavity is the kidney and the retroperitoneal tissue surrounding the kidney. A one centimeter incision is first made in the patient's skin using local anesthesia. The distal end of the surgical device is then inserted through the incision with the retraction levers 28 closed. The surgical device is advanced until the muscular layers overlying the kidney are reached. The retraction levers 28 are then opened by means of the tongs 80 and suction is applied through the hoses 82 to draw fluid from the cavity produced. Air can enter the cavity through the fluid passageway 72 to replace the fluid removed.

When the surgical device is first inserted through the incision the surgeon can use the viewing system to see muscular tissue through the space between the retraction levers. The device can be pushed forward, and the retraction levers opened, spreading the muscular tissue in the classic "blunt disection" technqiue. Bleeding can be reduced and controlled by coagulation by laser radiation through either the viewing system or the laser light transmitting fiber. After penetrating through the muscular layers, the retroperitoneal tissue in the area of the kidney becomes visible. This tissue can also be parted to make the kidney visible.

The kidney is highly mobile especially during patient respiration. To immobilize the kidney, the retraction levers may be advanced and placed against the kidney capsule. The surgeon can then advance a biopsy tissue collecting means through the surgical device and into the kidney. The biopsy means collects its sample and any excessive bleeding can be controlled by laser irradiation. The

retraction levers are then closed and the device is removed from the patient. The skin wound may be closed by a single suture or by an adhesive strip bandage. The patient is thus spared the risk of a totally blind biopsy procedure and the risk and discomfort of a major surgical procedure which would otherwise be necessary.

Another use of the present invention is for spinal disc surgery. The problem with this disease is not inside the spinal canal, but rather near the lateral formina at the exit of the spinal nerves. At this point, rupture or egress of the spinal disc (a gelatinous material) compresses on a nerve root causing severe pain.

The spinal column can be approached inferolaterally with the surgical device. A space is then created between the vertabral processes with the retraction levers so the impinging disc can be seen. With proper care, laser irradiation can be used in short bursts to severe a piece of the disc at some distance from the nerve. The tissue retraction levers can then be closed to grasp the severed portion of the disc. The surgical device and severed portion of the disc are then removed.

The foregoing specification is intended as illustrative and is not to be taken as limiting. Still other variations within the spirit and scope of this invention are possible and will readily present themselves to those skilled in the art.

WHAT IS CLAIMED IS:

1. A surgical device for the visual inspection of tissue within a patient comprising:

a) an elongated external tube having proximal and distal end portions;

b) a viewing system extending into the tube;

c) a retraction member operably associated with the distal portion of the tube; and

d) actuator means for urging at least a portion of the retraction member radially outwardly of the tube;

whereby the retraction member and a portion of the tube can be inserted into the patient and the actuator means and retraction member engaged to facilitate inspection with the viewing system.

2. The surgical device of claim 1 including an access channel extending within the external tube.

3. The surgical device of claim 1 including hinge means for pivotably mounting one end of the retraction member on the distal portion of the tube.

4. The surgical device of claim 1 including at least one fluid hose extending through the external tube with a portion of the hose carried by the retraction member.

5. The surgical device of claim 4 wherein one end of the hose is fixed on the retraction member and the retraction member can be urged inwardly by tension placed on the hose.

6. The surgical device of claim 1 wherein the actuator means urges the portion of the retraction member outwardly of the tube as at least a portion of the viewing is moved relative to the tube.

7. The surgical device of claim 1 wherein the actuator means includes a mechanical linkage between the viewing system and the retraction member

for urging the portion of the retraction member outwardly of the tube as the viewing system is moved longitudinally relative to the tube.

8. The surgical device of claim 1 wherein the actuator means includes camming means carried by the external tube and viewing system for urging the portion of the retraction member outwardly of the tube as viewing system is moved longitudinally relative to the tube.

9. The surgical device of claim 1 including directing means for deflecting the distal portion of the viewing system relative to the axis of the tube.

10. The surgical device of claim 9 wherein the directing means includes at least one cable carried by the viewing system and having one end fixed on the distal portion of the viewing system.

11. The surgical device of claim 1 including means for emitting laser irradiation carried within the tube.

12. A surgical device for inspection of tissue within a patient comprising:

a) a substantially rigid, elongated external tube having proximal and distal end portions;

b) a substantially rigid internal conduit having a probe end and mounted for longitudinal movement within the external tube;

c) a viewing system carried by the internal conduit;

d) hinge means on the distal portion of the tube;

e) a pair of tissue retraction levers, each lever having a distal end, and a mounting end pivotably mounted on the distal end portion of the tube by the hinge means; and

f) actuator means for urging the distal ends

of the retraction levers apart as the internal conduit is moved longitudinally with respect to the external tube.

13. The surgical device of claim 12 wherein the internal conduit defines an access channel.

14. The surgical device of claim 12 including at least one fluid hose extending through the external tube, the end of the hose being fixed adjacent the distal end of one of the tissue levers.

15. The surgical device of claim 12 including a biopsy sampling means extending through the external tube for collecting tissue.

16. The surgical device of claim 12 wherein the actuator means includes a mechanical linkage between the internal conduit and the retraction levers for urging the distal ends of the tissue levers apart and together.

17. The surgical device of claim 12 wherein the actuator means includes camming means carried by the external tube and internal conduit for urging the distal ends of the retraction levers apart as conduit is moved longitudinally relative to the tube.

18. The surgical device of claim 12 including a second pair of retraction levers pivotably mounted on the distal portion of the tube by the hinge means, the four retraction levers matingly fitting together to form a sheath.

19. The surgical device of claim 12 including means for transmitting laser light through the viewing system.

20. The surgical device of claim 12 including a laser light transmitting fiber carried by the internal conduit.

21. The surgical device of claim 20 wherein the viewing system and laser light transmitting fiber

extend within the internal conduit and are substantially coterminous with the probe end.

22. The surgical device of claim 12 wherein the distal portion of the internal conduit is flexible to facilitate deflection of the probe end relative to the axis of the internal conduit and including directing means for deflecting the probe end.

23. The surgical device of claim 22 wherein the directing means includes at least one cable carried by the viewing system and having one end fixed on the distal portion of the internal conduit.

AMENDED CLAIMS
[received by the International Bureau on 25 July 1983 (25.07.83)
original claims 6, 7, 8, 16 and 17 cancelled; remaining claims renumbered;
original claims 1,2,12 and 13 amended; new claims 19, 20 and 21 added]

1. A surgical device for the visual inspection of tissue within a patient comprising:

a) an elongated external tube having proximal and distal end portions;

b) a viewing system extending into the tube;

c) a retraction member operably associated with the distal portion of the tube; and

d) actuator means carried by the device and including camming means carried by the external tube and viewing system for urging at least a portion of the retraction member radially outwardly of the tube as the viewing system is moved longitudinally relative to the tube;

whereby the retraction member and a portion of the tube can be inserted into the patient and the actuator means and retraction member engaged to facilitate inspection with the viewing system.

2. The surgical device of claim 1 including an instrument access channel extending within the external tube.

3. The surgical device of claim 1 including hinge means for pivotably mounting one end of the retraction member on the distal portion of the tube.

4. The surgical device of claim 1 including at least one fluid hose extending through the external tube with a portion of the hose carried by the retraction member.

5. The surgical device of claim 4 wherein one end of the hose is fixed on the retraction member and the retraction member can be urged inwardly by tension placed on the hose.

6. The surgical device of claim 1 including directing means for deflecting the distal portion of the viewing system relative to the axis of the tube.

7. The surgical device of claim 6 wherein the directing means includes at least one cable carried by the viewing system and having one end fixed on the distal portion of the viewing system.

8. The surgical device of claim 1 including means for emitting laser irradiation carried within the tube.

9. A surgical device for inspection of tissue within a patient comprising:

a) a substantially rigid, elongated external tube having proximal and distal end portions;

b) a substantially rigid internal conduit having a probe end and mounted for longitudinal movement within the external tube;

c) a viewing system carried by the internal conduit;

d) hinge means on the distal portion of the tube;

e) a pair of tissue retraction levers, each lever having a distal end, and a mounting end pivotably mounted on the distal end portion of the tube by the hinge means; and

f) actuator means including camming means carried by the external tube and internal conduit for urging the distal ends of the retraction levers apart as the internal conduit is moved longitudinally with respect to the external tube.

10. The surgical device of claim 9 wherein the internal conduit defines an instrument access channel.

11. The surgical device of claim 9 including at least one fluid hose extending through

the external tube, the end of the hose being fixed adjacent the distal end of one of the tissue levers.

12. The surgical device of claim 9 including a biopsy sampling means extending through the external tube for collecting tissue.

13. The surgical device of claim 9 including a second pair of retraction levers pivotably mounted on the distal portion of the tube by the hinge means, the four retraction levers matingly fitting together to form a sheath.

14. The surgical device of claim 9 including means for transmitting laser light through the viewing system.

15. The surgical device of claim 9 including a laser light transmitting fiber carried by the internal conduit.

16. The surgical device of claim 15 wherein the viewing system and laser light transmitting fiber extend within the internal conduit and are substantially coterminous with the probe end.

17. The surgical device of claim 9 wherein the distal portion of the internal conduit is flexible to facilitate deflection of the probe end relative to the axis of the internal conduit and including directing means for deflecting the probe end.

18. The surgical device of claim 17 wherein the directing means includes at least one cable carried by the viewing system and having one end fixed on the distal portion of the internal conduit.

19. The surgical device of claim 9 wherein the camming means includes a bead carried by the viewing system and a tab associated with the retraction member, the bead and tab cooperating to urge at least a portion of the retraction member

radially outwardly of the tube as the viewing system is moved longitudinally relative to the tube.

20. The surgical device of claim 9 wherein the camming means includes a bead carried by the internal conduit and a pair of tabs respectively on the retraction levers.

21. The surgical device of claim 20 wherein the tabs are mounted on the retraction levers adjacent the hinge means.

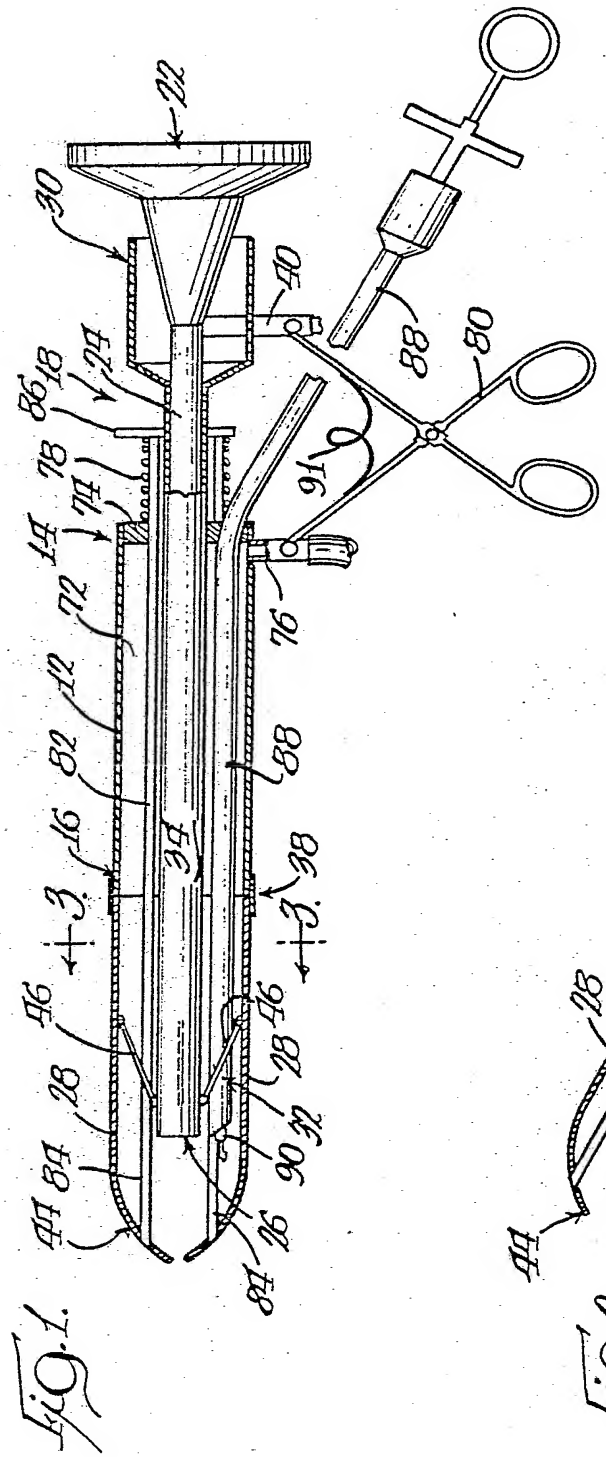


FIG. 1.

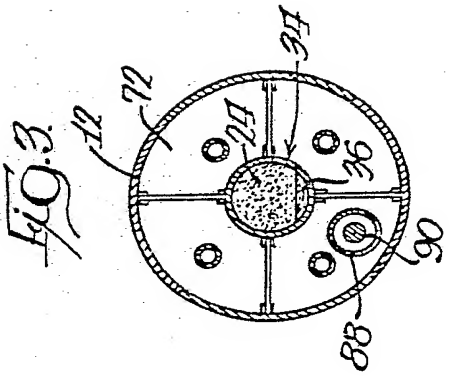


FIG. 3.

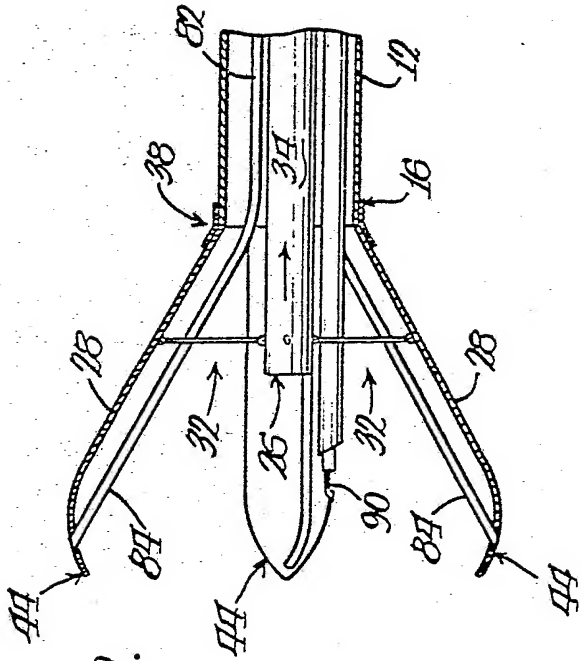


FIG. 2.

Fig.4.

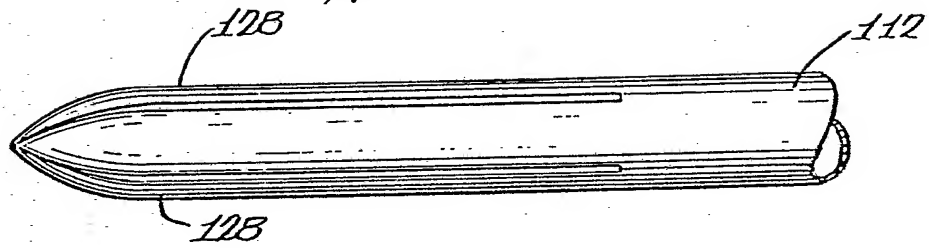


Fig.5.

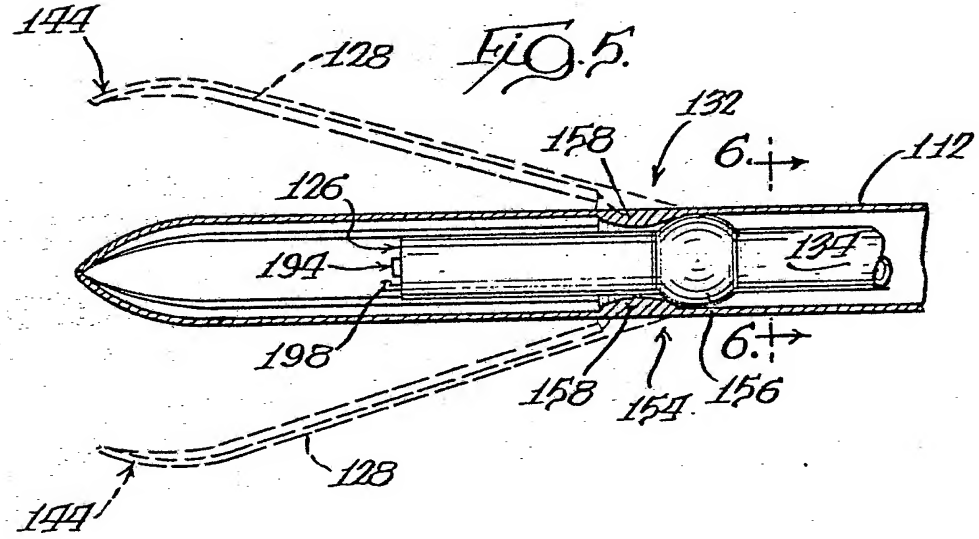


Fig.6.

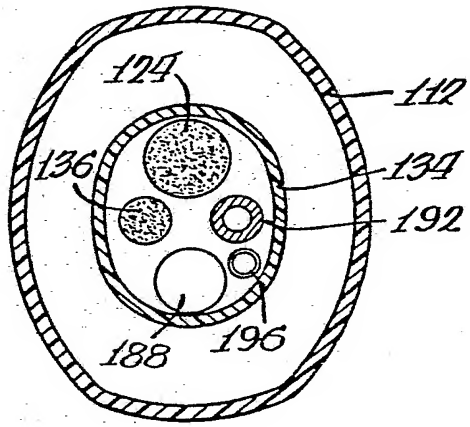


Fig. 7.

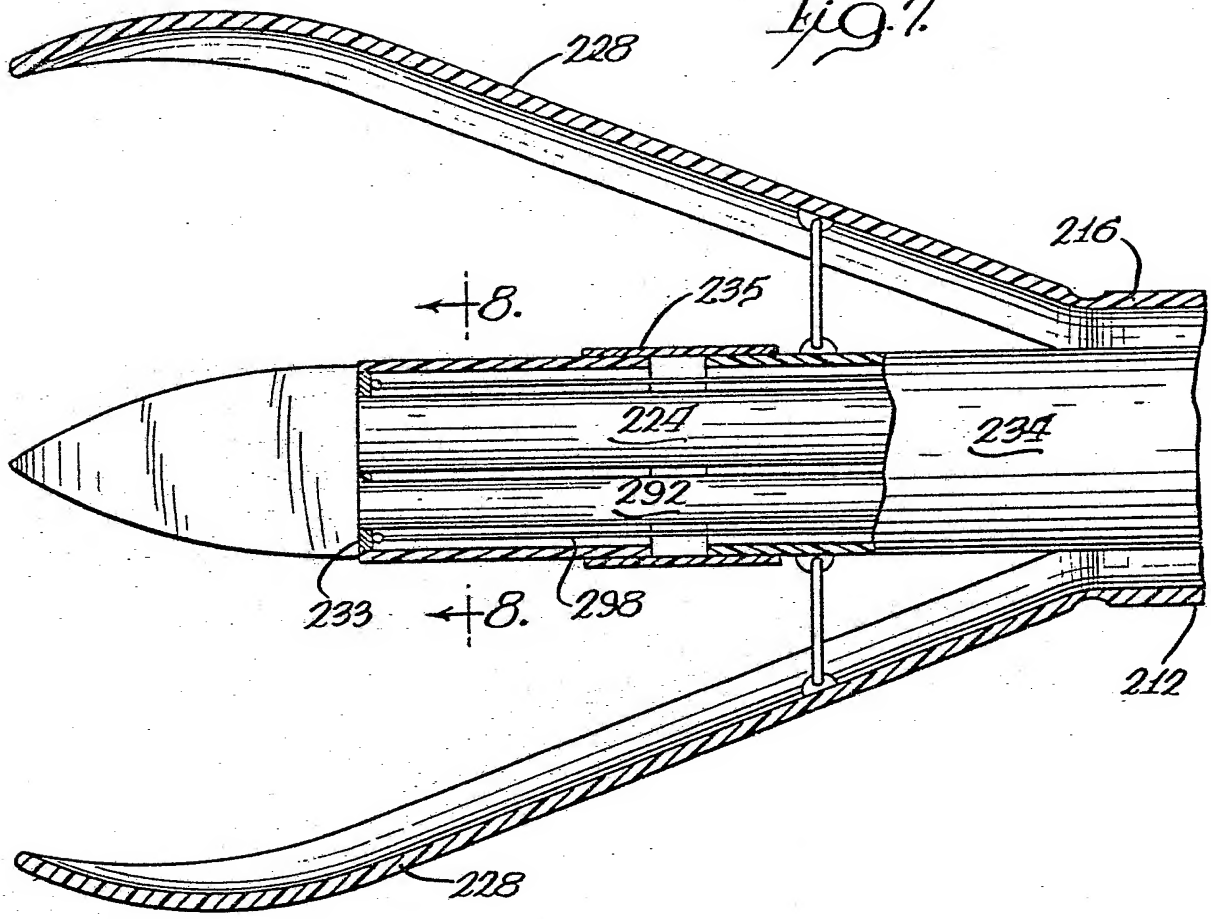
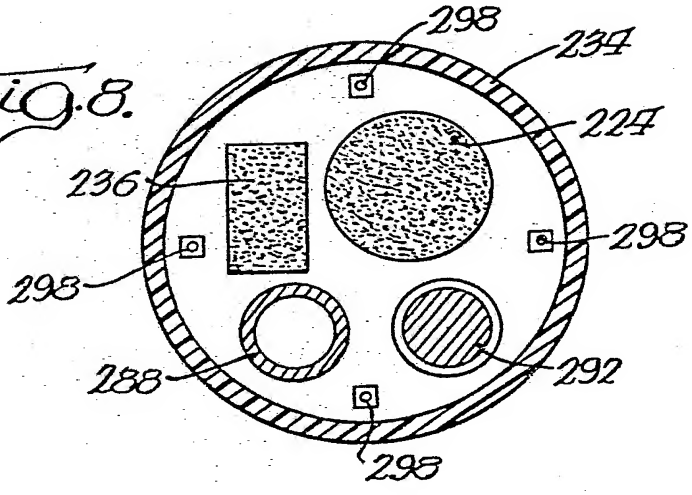


Fig. 8.



INTERNATIONAL SEARCH REPORT

International Application No PCT/US83/00360

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl.[3] A61B 1/06 U.S. Cl. 128/6

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
U.S.	128/3-11,17-20,22,345

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [5]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
X	US,A, 2,621,651 Published 16 December, 1952, Wallace	1-23
Y	US,A, 4,146,019 Published 27 March 1979, Bass et al	2,11,13,15 19-21
Y	US, A, 3,799,151 Published 26 March 1974, Fukaumi et al	9,10,22,23
Y	US,A, 1,624,716 Published 12 April 1927, Cerbo	7,16
Y	US,A, 765,879 Published 26 JULY1904, Campbell	8,17
Y	US,A, 2,483,233 Published 27 Septmber 1949, Price et al.	4,5,14
Y	IT,A, 483,587 Published 5 August 1953, Marchi	18

* Special categories of cited documents: [15]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search [2]	Date of Mailing of this International Search Report [2]
9 May 1983	25 MAY 1983
International Searching Authority [1]	Signature of Authorized Officer [20]
ISA/US	Max F. Hindenburg for Kyle L. Howell

Form PCT/ISA/210 (second sheet) (October 1981)